End connection

The invention relates to a sling, a cord or a rope as claimed in claim 1 and applications thereof as claimed in claims 12-15.

Slings are woven from belt fabrics or belt tubing and thus sewn and produced such that a continuous sling is formed. These slings have the disadvantage that they must have a major thickening at the connection site or the seam in order to obtain the required standard strengths. Furthermore, the fabrics must be constructed and woven with very high strengths to compensate for the sewing loss at the seam. Likewise a certain width or thickness of the belt material paired with the strength of the materials used in weft and woof must be woven with a certain type of weave in order to achieve the prescribed strengths.

The slings however should also have an extremely small cross section, the smallest possible thickening at the seam and also low weights mainly in the areas of sports, recreation, hobbies and industrial safety.

US 5,873,613 discloses a mechanical element which is connected to a belt sling with overlapping ends with a climbing rope. The disadvantage here is that the seam for joining the overlapping ends entails a strength loss of 25-30%. Moreover the seam constitutes a considerable hindrance for slippage in the stop element; this is also associated with increased wear.

US 5,829,374 discloses an especially sewn end connection on a rope which has special properties for high end connection strength.

US 4,396,091 discloses a sling which has been attached to a safety belt or harness and which has self-regulating adjustability.

US 4,083,521 discloses a mechanical element for use in sports climbing which is connected

to a sling or a rope sling.

Furthermore WO 03/059462-A1 discloses a sling which is made on one end as a tube, the other end of the tube being pushed into the tube and sewn.

The object of this invention is to propose an end connection for a sling, a cord or a rope which has only insignificant thickening and low weight at high tensile strength.

As claimed in the invention, this object is achieved with an end connection according to the wording as claimed in claim 1, and with applications according to the wording as claimed in claim 12-15.

The invention is detailed below using the drawings.

Figure 1 shows a view of an end connection as claimed in the invention

Figure 2 shows an end connection with widened end parts

Figure 3 shows an end connection with end parts of different lengths

Figure 4 shows an end connection with bonded end parts

Figure 5 shows an end connection with sewn end parts

Figure 6 shows an end connection with a belt-like and a rope-like end

Figure 1 shows the view of an end connection as claimed in the invention. One end connection 10 consists for example of a belt-like or a rope-like article, with two ends 1, 2. One end 1 runs into at least a first end part 3 and the other end 2 runs into at least a second end part 4.

In a belt-like article or fabric the warp threads are divided for example into three groups with the same thread number which lead to woven end parts 3, 3' of the same thickness. This division need not be uniform; this then leads to end parts 3, 3' of unequal thickness. Since the total number of warp threads in the end parts however corresponds to those of the ends 1, 2, the total of

the thicknesses of the end parts corresponds to that of the thickness of the corresponding end 1, 2.

The end parts 3, 4 are pushed into one another or placed on one another so that they entirely or at least partially overlap. In the area of this overlapping there is a connecting site 5 on which the end parts are connected. This takes place for example by sewing, cementing, heat-bonding or ultrasonic bonding, depending on the type of belt-like or rope-like article present.

The connecting site 5 in the transition from the end part 3 to the end part 4 has a joint 6 at which there is a thickening which is generally less than 50% compared to the thickening of 100% which forms when two ends of the same thickness overlap.

One advantage of this end connection lies in the greater flexibility in the transition or at the joint. Another advantage is the more uniform thickness of the surfaces, and by virtue of the end parts, increased strength.

The belt-like article is for example a plastic-coated belt or a plastic or fabric belt. Belt-like or rope-like articles consist of an extruded, cast or pressed plastic.

The two ends 1, 2 need not be necessarily be made symmetrical, either with respect to the material used, nor with respect to shape. Thus one end can consists of a belt-like article and the other can consist of a rope-like article. Furthermore, the rope-like article can be a cord or a rope as is described below.

A sling with an end connection as claimed in the invention is connected, suspended with fastening means, such as carabineers, hooks, eyes, plastic parts, aluminum robs or steel tubes, or parts are injected or cast thereon so that the diameter or cross section of the end connection is as small as possible at these points.

The end connections are woven, knitted, braided, twisted, cast or extruded, that at certain

points they have wider cross sections than at other points and are present in loop form or as a sling. The two ends are then joined into a sling in endless form or a loop and are matched in diameter or in cross section such that one end has room within the other end. Sewing, bonding or mechanical anchoring of the ends which have been pushed into one another yields a much higher connection strength by the at least doubled area of the ends.

The end connections are used as full slings in endless form. End connections of this type are used in stop slings for attachment of climbing safety systems, ropes, belts, fall dampers or in slings for attachment to hooks, trees, beams, iron bars and the like.

Figure 2 shows a top view of an end connection with widened end parts. The ends 1, 2 run into the end parts 3, 4 which are made widened with respect to the width of the ends. The two end parts are shown here without overlapping, i.e. before they are pushed into one another or placed on one another, and connected. The considerably widened area at the connecting site offers the following advantages: Higher strengths and a slight thinning of the end connection with respect to the remainder of the product can be achieved. For example, a sling with a cross section of 5 x 5 mm after widening on the end connection has only a cross section of 10 x 2.5 mm.

Figure 3 shows an end connection with end parts of different lengths. The ends 1, 2 run into the end parts 3, 3' and into the end parts 4, 4' which are made of different lengths. The end parts 3', 4' project over the end parts 3, 4, by which when placed on one another three end parts 3, 4', 3' and 4, 3', 4' or only two ends parts 3', 4' can be connected in places. This can be especially advantageous when especially small thickening is desired. Depending on the choice of materials used, here it is possible to optimize between the thickness of the end parts, the type of their overlapping and the underlying materials.

Figure 4 shows an end connection with bonded end parts. The ends 1, 2 run into the end parts 3, 4 which are made the same length. The end parts 3, 4 are pushed completely into one another and adjoin one another in the areas 7, 7' where they are present bonded. Advantages of a connection by bonding are mainly more efficient production, but also higher strength with respect to sewing, for example.

The end 2 can also be present with unequal end parts compared to the end parts of the end 1. For example, the end 2 can run into only one end part 4, or can be subdivided into three end parts. Depending on the execution of the end parts, then there are two or more connecting sites or bonding sites. The strength in turn increases with multiplication, i.e. with several of these connecting sites present.

Ultrasonic bonding as well as cementing of the different connecting sites has proven advantageous.

Figure 5 shows an end connection with sewn end parts. The end parts 1, 2 and the end parts 3, 4 correspond to Figure 4. The connection is made by sewing; this is shown with a suggested seam 8 which generally extends over the entire region of the overlapping end parts. It can also extend or be divided only partially over this region. The sewing constitutes a reliable connection which can be easily checked at any time with respect to its quality (visual inspection).

Figure 6 shows an end connection with one belt-like and one rope-like end. The belt-like end 1 runs into two end parts 3. The rope-like end 2 is made as a cord and is at the same time also an end part with a round, oval or flat cross section 9. In this way a loop can be made more reliable, thinner and more flexible on the end connection.

End connections consist of elastic or semielastic material such as synthetic rubber or

Aramid, Dyneema, PEN (polyester) which can be stretched over a certain distance and afterwards has high end strength. A sling with such an end connection for example has a length of 60 cm and at 20% stretching a length of 70 - 80 cm. The length of the sling however can vary between 5 cm and a maximum 8 m at correspondingly matched cross sections.

Generally these belt-like and/or rope-like articles consist of a combination of materials which differ from one another with respect to elasticity, stretching behavior, cutting resistance, tear resistance, and wear resistance, by which there is an optimum of tensile strength, wear and cutting resistance at low weight.

Materials for these end connections and the products made with them include high strength fibers of Zylon, Vectran, PBO, Dyneema, Kevlar, Aramid, polyester, polyamide and polypropylene, individually or in combination.

Embodiment of the end connection for a sling for sport climbing: One belt-like end 1 with a narrow cross section (7 mm belt) for hanging a carabineer runs into two end parts 3 of the same thickness, while one belt-like end 2 with a wider cross section (12 mm belt) runs into two ends parts 4 likewise of the same thickness. The end parts are placed on one another as described in Figure 5, and are sewn in the overlapping region. The end connection consists of Dyneema (70%) and polyamide (30%). The sling with this end connection has a length of 60 cm and with 2% stretching a length of 61.2 cm.

These end connections and products produced therefrom are generally used in sports climbing for example as a climbing sling, or as a stop sling in the industrial safety domain, but also in sailing, surfing and water sports. These end connections are used furthermore also as an end connection element of a cord or a rope.